PATENT SPECIFICATION

670,313

Date of filing Complete Specification (under Section 16 of the Patents and Designs Acts, 1907 to 1946): Oct. 18, 1948.

Application Date : Oct. 21, 1947. No. 28096/47.

Application Date : Dec. 24, 1947. No. 34164/47.

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PROVISIONAL SPECIFICATION

SPECIFICATION NO. 670,313

INVENTOR:- FELIX MEYER

By a direction given under Section 17(1) of the Patents Act 1949 this application proceeded in the name of Sterling Drug Inc., a corporation organised according to the laws of the State of Delaware, of 1450, Broadway, New York, 18, State of New York, United States of America.

THE PATENT OFFICE,

17th June, 1955

DB 78137/1(1)/3376 150 6/55 R

ing and sealing them, for example in a continuous manner and the invention is also concerned with the provision of devices and mechanism for carrying out this method of production.

Among the advantages of the invention is that it is cheap and simple to carry out, that it provides an easy and continuous method of making and filling containers and that the method makes it unnecessary to seal the containers under vacuum. It may also be mentioned that with containers produced in accordance with this invention it is not necessary to store the filled containers under special conditions, e.g. in a cold state, in order to prevent deterioration of the contents as will be explained hereinafter and with containers in accordance with this invention preservatives and the like are not necessary in order to safeguard the contents. These advantages are obtained owing to the fact that during manufacture, filling and sealing of the containers air is substantially completely excluded. In known containers it is the presence of appreciable quantities of air in the containers that is sometimes responsible for deterioration of the contents and this is avoided by technique embodying the invention. The expulsion of air, as will be hereinafter explained takes place not because of heating or the use of vacuum conditions but in accordance with a feature of the invention the contents of the containers expels the air during filling and an excess

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effected by melting the end of each container wall, sealing it and at the same time forming the bottom of the following container so that as the top end of a filled container is sealed the excess of contents is pushed out into the next container and the bottom end of the next container sealed off and closed more or less all in one operation.

It will be understood from the above therefore that the present invention is concerned only with the manufacture of containers which are to be filled with liquid or paste the surplus of which can be squeezed out into a following container and that the invention has no application in connection with containers adapted to hold solids or other contents which cannot be obtained free from air.

The present invention therefore is particularly applicable for use in connection with liquids or pastes forming foodstuffs, condiments or medicaments and especially such materials which are to be consumed almost immediately on the opening thereof. Hitherto containers such as bottles, jars, ampoules and the like for holding liquids and pastes have usually been made from glass. Glass from most points of view is very satisfactory but it nevertheless suffers from one or two inherent disadvantages such as its liability to breakage and in the case of sealed glass ampoules the difficulty of opening satisfactorily. Containers according to the present invention which are more or less resilient

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PROVISIONAL SPECIFICATION.

Improvements in or relating to the manufacture of plastic fluid containers, especially ampoules

I, FELIX MEYER, of 112 Avenue Moliére, Brussels, Belgium, of German nationality, do hereby declare the nature of this invention to be as follows:—

This invention relates to the manufacture of containers such as ampoules, bottles and the like and particularly to the manufacture of resilient hollow containers which are shaped, filled with liquid or paste and are sealed in an air-tight manner in a continuous operation. The invention also relates to the provision of a method for the manufacture of such containers including the steps of filling and sealing them, for example in a continuous manner and the invention is also concerned with the provision of devices and mechanism for carrying out this method of production.

Among the advantages of the invention is that it is cheap and simple to carry out, that it provides an easy and continuous method of making and filling containers and that the method makes it unnecessary to seal the containers under vacuum. It may also be mentioned that with containers produced in accordance with this invention it is not necessary to store the filled containers under special conditions, e.g. in a cold state, in order to prevent deterioration of the contents as will be explained hereinafter and with containers in accordance with this invention preservatives and the like are not necessary in order to safeguard the contents. These advantages are obtained owing to the fact that during manufacture, filling and sealing of the containers air is substantially completely excluded. In known containers it is the presence of appreciable quantities of air in the containers that is sometimes responsible for deterioration of the contents and this is avoided by technique embodying the invention. The expulsion of air, as will be hereinafter explained takes place not because of heating or the use of vacuum conditions but in accordance with a feature of the invention the contents of the containers expels the air during filling and an excess of contents is present up to sealing. In other words, the vessels or containers are filled and sealed in such a manner that an excess of the contents is present in each successive container up to the moment when it is sealed. This excess of contents ensures that the container is as far as possible free of air and then the excess in the final closing and sealing of the open end of the container, is forced out into the following vessel or container which is then treated in the same manner.

The closing and sealing of the end may be effected by melting the end of each container wall, sealing it and at the same time forming the bottom of the following container so that as the top end of a filled container is sealed the excess of contents is pushed out into the next container and the bottom end of the next container sealed off and closed more or less all in one operation.

It will be understood from the above therefore that the present invention is concerned only with the manufacture of containers which are to be filled with liquid or paste the surplus of which can be squeezed out into a following container and that the invention has no application in connection with containers adapted to hold solids or other contents which cannot be obtained free from air.

The present invention therefore is particularly applicable for use in connection with liquids or pastes forming foodstuffs, condiments or medicaments and especially such materials which are to be consumed almost immediately on the opening thereof. Hitherto containers such as bottles, jars, ampoules and the like for holding liquids and pastes have usually been made from glass. Glass from most points of view is very satisfactory but it nevertheless suffers from one or two inherent disadvantages such as its liability to breakage and in the case of sealed glass ampoules the difficulty of opening satisfactorily. Containers according to the present invention which are more or less resilient

[F]

may be made from suitable thermoplastic material which by the application of pressure and/or heat melts or becomes plastic and adhesive so that on cooling adjacent lengths or parts adhere together firmly to each other. Synthetic thermoplastic material is particularly suitable e.g. a synthetic resin such as a thermoplastic cellulosic material among which ethyl cellulose or cellulose acetate may be mentionetd. Polyamides may also be used or polyvinyl compounds including polyvinyl ester or polyvinyl chloride with or without polyvinyl acetate. Many suitable plastic masses are already available on the market such as polystyrene, nylon, cellon or polythene. In this connection it is advisable to use materials the melting point of which is as high as possible so that sterilisation of the filled and closed containers may be more readily effected without injurious consequence. For example sterilisation may readily be effected in boiling water as long as at such a temperature the containers do not undergo any objectionable change such as an alteration in shape.

It may, however, be mentioned that such an alteration in shape of the containers is substantially avoided as long as the heat does not cause a direct melting of the walls of the containers in as much as the containers are unable to contract by reason of the fact that they are filled with a non-compressible liquid which does not allow of contraction. It will be understood therefore that generally speaking external pressure can have no injurious consequences but it is an advantage for the material to be slightly extensible since during sterilization internal pressures may be set up.

Now in accordance with the present invention there is provided a method of making filled containers comprising forming thermoplastic material into a tube, feeding the contents into the tube and then dividing the filled formed tube into a number of containers in such a way that the excess liquid from one container is forced out during sealing thereof into the next container. In more detail the thermoplastic material may be formed into a flexible pipe or tube with one end closed. Into this tube the liquid contents is fed, the closed end preventing escape of liquid. After a certain length of the tube has been filled the other end of the tube may be closed to form a length of tube filled with liquid and closed at each end. This tightly filled tube can then be divided into a number of separate filled containers rather like a string of sausages. This method of manufacture permits a continuous production, to a limited extent, in which the artificial substance to form the containers may be drawn like a sausage skin over a nozzle and may be drawn gradually away from the nozzle by the contents at the rate the contents enter the tube. To attain the object of the invention, the plastic mass still adapted to be shaped may be expelled from a nozzle by means of great pressure while the mass is in the hot state and may be formed into a tube. At the same time the contents may be conveyed through an orifice in the core of the nozzle into the tube so formed, whereupon in the above-described manner the tube may be continuously subdivided into sections and if necessary these may at the same time be separated into individual containers.

I have found however that it is particularly advantageous to start from two or more wound bands which may be used in endless lengths. These bands may be shaped into a tube by carrying the longitudinal edges along devices which fuse them together by heat. In a simple arrangement two tapes may be employed but it will be understood that if desired three, four or even more tapes could be used to form for example containers of special size or shape, for example approximately square, rectangular or triangular in cross-section.

In a further alternative arrangement, the tube may be formed from one tape of thermoplastic material which may be folded longitudinally thereof and the overlapping edges joined together in a suitable manner as by heat and pressure for example or by the use of a solvent; in this manner a tube may be made with a single longitudinal seam. In a modified arrangement a tube may be made from a single tape by winding it in spiral form so that instead of having one join extending longitudinally of the tube the join is a spiral one and the overlapping edges may be secured in any suitable manner for example as described above. In a similar manner a tube may be manufactured by helically winding two or more such tapes, once again the overlapping edges of the tapes being secured together to form a liquid-tight tube. One end of the tube may be closed by sticking together the open end of the tube and the contents may enter the short length of tube so formed through a pipe projecting into the tube. The arrangement may be such that the end of the tube is at a higher level than the members which effect the closing of the sections and the level of the liquid in the tube may be kept always at the same level and higher than the closing point. In this way with each closing of a section of the tube to form a container a part of the contents passing into the following section of the tube ensures complete filling of the next section or container to be formed. The closing may be arranged to take place at right angles to the edges when there are no special reasons for a different shaping. Some examples of particular shaping of the bottom and of the top

end of a container will be given hereinafter.

If it is desired that the contents of the containers should be forced out for use gradually in the form of a thin band or rod like tooth paste out of a tube, then the closing of the upper end of a container does not require a straight line but a neck should be formed merging into a tip. Such a shape may be produced by forming a corresponding recess in the bottom of the following container so that each container produced is in shape something like a wine bottle. Such shapes are particularly suitable for contents having a dough-like consistency.

In another case for example, the contents may be milk or some similar liquid intended for suckling or infant food, then the upper closing may be formed like a teat. In use after the piercing of a few holes in the teat, this can serve at once for the suction of the milk or other liquid contents. The infant can drink the contents without interruption as, contrary to glass vessels, in consequence of the collapse of the non-rigid wall there is no need to allow the inlet of air into the vessel.

In another example in the manufacture of ampoules for preserving medicaments for injection, the closing part may be of such shape that a hollow needle can be fitted in the same way as with the injection nozzle.

As required containers of other shapes may be manufactured.

An apparatus suitable for the production of containers according to the invention will now be described by way of example.

Two rollers carrying wound bands of suitable material are located on a plate preferably downwardly inclined. In unwinding the material which takes place continuously, the longitudinal edges of the bands pass between two forming rollers kept at the same temperature and which form the bands into a tube by fusing the edges. The forming rollers may be so recessed that they force only the edges of the bands together, leaving the remainder free and allowing room for the introduction of a filling pipe through which liquid may be fed into the tube.

It may be pointed out that in addition to the forming rollers melting the two longitudinal edges, other rollers can also be fitted parallel thereto and thus a number of vessels can be simultaneously produced adjacent to each other, which might appear advisable in the mass production of for example small ampoules.

The whole apparatus preferably stands under a glass cover which need only have a small opening at the top through which the liquid pipe passes, and having necessarily a slot at the bottom through which the band of filled containers can pass out of the glass chamber. These containers in band form may then be either cut apart for further treatment (boiling, testing for air-tightness) or for the time being may remain connected together. As an alternative or additional method of sterilization to that mentioned above, the material used to form the tube may be sterilized immediately before being shaped into the tube. For example, tapes of thermoplastic material may be unwound from rollers and may be formed into a tube, these tapes may be sterilized immediately before formation of the tube by passing the tapes through a bath of sterilizing liquid and then drying them in any suitable manner. If desired the rolls of tape may be immersed in a bath of sterilizing liquid, may be unwound and passed through squeezing rollers to remove excess liquid, then dried for example in hot sterile air and then at once formed into the tube.

Various advantages will now be mentioned which particularly stand out for the production of injection ampoules.

Apart from the inherent advantages given by the use of the thermoplastic materials in place of glass, for example unbreakability, chemical neutrality to acid, alkalies, and the like, particular advantages may be pointed out which arise from the manner of making these new ampoules.

There may be first mentioned the possibility of a more exact dosing of the contents than has hitherto been possible since irregular thicknesses of wall do not have to be reckoned with especially when the containers are manufactured by the method using a tube formed from two bands of material. It will be understood that these bands are always substantially of the same thickness and as both the production of the longitudinal edges and the production of the transverse closures takes place positively, the inner space and the contents will be always approximately the same, which plays an important part in particular with costly medicaments.

In the case of the invention, the tedious filling, cleaning, closing, printing, packing and the like, necessary with hitherto known ampoules, is dispensed with. The bands in consequence of the nature of their production will be already clean and free from foreign bodies. Using the arrangement outlined above as an example, the precautions for cleanliness hitherto taken are now unnecessary as no hand comes into contact with the ampoules while they are unfilled and not closed. Under certain circumstances, the entire production can take place in an atmosphere free from oxygen. The pipe through which the liquid is conveyed can enter the chamber in an air-tight manner and if necessary from below. This chamber can be so extended that the prepared ampoules collect therein and are only removed periodically. A gas can be intro-

duced into the hermetically closed space, in which the whole process takes place, which gas expels the air, for example working can take place under an atmosphere of nitrogen or hydrogen, so that if the liquid has been previously deprived of air by boiling or in a vacuum, danger of the penetration of oxygen is avoided.

The indication of the contents of the ampoules can take place by previous printing of the bands. This can also take place during the production of the ampoules, for example by printing rollers provided with ink effecting the printing on the bands as they are unwound before their joining along the longitudinal edges. Markings can also be provided along the edges by stamping, by means of heated stamping rollers, running over them, with letters, numbers and so on.

As the walls of the ampoules need only have the thickness of a fraction of a millimetre, the point of the hollow needle by which the contents can be aspirated for use into the injector, as already proposed, cannot be bent or made blunt. With ampoules which contain drinkable substances such as oral medicaments and the like, the tip or point which forms at the edges can be bitten off or cut off by scissors.

As has already been mentioned, the ampoules or other containers can remain attached together and as already above described the outer edges can not only be closed by hot rollers but in the same way the flexible tube formed can be subdivided in the longitudinal direction and this either before or after the filling. If, for example, the tube has a width of 10 or 20 cm. then at distances of 1 or 2 cm. a heated roller can run which subdivides the tube into 10 or 20 chambers in the longitudinal direction, so that on the transverse subdivision a corresponding number of ampoules simultaneously arise. A quantity of ampoules sufficient for a cure can then be packed, despatched and gradually emptied while being united. This produces a block of containers similar to a slab of chocolate with longitudinal and if necessary also with a number of transverse grooves. If it is desired that such a slab or plate should present bulges on one side only, the thickness of the bands to be united can be so chosen that one band bulges out on filling, whilst the other band remains flat.

If the arrangement is such that delivery pipes of different liquids open into the running tube and if the subdivision in the length is such that by the continuing fusing of the said longitudinal ribs a separation of the different liquids is ensured, then connected ampoules with different contents can be produced which is advantageous if a mixture of the contents is only to take place at the moment of use. The physician who takes these contents, first pieces the one wall and aspirates the contents, then pierces further into the adjacent ampoule and aspirates its contents, so that the two contents mix in the syringe.

In a large number of cases it is a requirement for one liquid to be combined only at the last moment with a pulverulent substance. This pulverulent material must, in many cases, be kept under vacuum. As it would be contrary to the essence of the invention to fill an ampoule with pulverulent or granular substances and liquid into the adjacent ampoules, it does not appear impossible to keep the latter in dry form under vacuum and only at the last moment to place the substance to be dissolved, which must be secured in the said manner, in a liquid which cannot exert any injurious influence on the preservation of the medicament and if necessary keep the powder not dissolved but in suspension. In this case, as above described, there can be placed in one chamber for instance the aqueous solvent, and in the adjacent chamber the suspension. It has, in fact, been found that the presence of small solid substances, for example those which can be found in suspension, present no obstruction for the fusing together according to the invention. If the bodies in such cases are not forced into the following ampoule, they are so incorporated by the soft plastic substance wall that they are entirely enclosed. Under certain circumstances, the closing edge or the separation edge must be made sufficiently wide so that the particles do not form a bridge through which a transfer of one content into the other can take place.

Thus, the improved process is suitable not only for homogeneous liquid or pasty masses but also for those which contain small solid particles in suspension.

It has been proposed with glass ampoules in the form of glass tubes of small size closed at the end by rubber stoppers, to pierce the stopper, withdraw the contents and then either use the contents in that form or mix it with the contents of another ampoule. With the improved ampoules, a similar procedure can be adopted, these cartridge-like ampoules being pressed by a rubber stopper firmly fitted in the holder, against the inner hollow needle point of a double needle, which pierces the wall and then compresses the whole ampoule in the longitudinal direction until the complete expulsion of the medicament has been effected. Naturally, by the introduction of a double-pointed hollow needle, the ampoule can also be emptied by lateral compression, through the hollow needle, without using the known Carpule (registered trade mark) syringe.

In this case, it is advisable to embed the

hollow needle in a clip with which one corner of the ampoule is compressed. The end of the needle is then forced through the wall. The jaws of the preferably spring-fastened clip press the two ampoule walls so firmly together that no liquid can pass out laterally and this on compression of the walls between thumb and first finger is compelled to pass out through the needle.

It may also be mentioned that according to the invention the thin walled easily collapsible vessels can without difficulty be provided with reinforced ribs. This is particularly desirable with vessels of larger dimensions such for example as the milk container to be used as a feeding bottle previously mentioned. It would be inexpedient if here the bottle being emptied were to crack or break.

For fitting on the reinforced ribs, first the edges formed may be made considerably wider than would be necessary simply for the melting and fusing together, then the edge may be carried along by its outer end on a considerably hotter member which so heats this edge that it fuses. On the fusing, the outer edge contracts in consequence of the surface tension into a thick roll or bead. This bead can be made as thick and thereby as strong as desired, and forms, to a certain extent, a rib for the otherwise very unrigid vessel.

As explained above, the present invention provides a method of manufacturing containers from thermoplastic material and especially for making ampoules but among other containers referred to above are milk bottles for infants and the invention includes features of making, filling, closing, sterilizing and using such containers as milk bottles as will be now more fully explained by way of example.

According to a feature of the invention a device for the extrusion of plastics is used for shaping a tube preferably having a thin wall. This extruding device is provided with a hollow die through which liquid, for example heated or warmed milk, may be fed into the tube while it is being shaped, the arrangement being such that the liquid fills the tube and no air from the outside is permitted to enter. The liquid filled tube which may be formed in a continuous manner by the extruding device may then be allowed to cool in order to attain a desired degree of plasticity and rigidity. Alternatively in some cases it may be necessary to warm the tube. In this connection we have found that if the tube is allowed to cool too much it may become too rigid to permit the next steps to be carried out while if it is too warm it may not be rigid enough and therefore there is a range of temperature into which the tube should be brought to give the required degree of rigidity and plasticity for the next steps.

At the proper temperature the tube may then be separated into single containers by the use of heated devices which together may operate to seal the end of each container. This sealing or welding device may be shaped in such a way that it creates or forms a bottle neck or other required shape for example a teat. The corresponding bottom of the following bottle or other container may have a concave form where the part which has served for forming the neck, teat or other special shape of the preceding container is missing.

By the above method containers e.g. milk bottles may be filled, sealed and provided in special shapes such as teat ended bottles in a continuous process.

As an alternative method, two bands of the plastic material may be used and formed into a tube in the manner described above. This tube may then be shaped into milk bottles.

When required for use the containers may be warmed or reheated to a desired temperature and in the case of a baby's bottle several small holes may be punctured in the teat. The infant who drinks the milk can empty the whole bottle, which, as it becomes more and more empty collapses, as described above, so that it is unnecessary to let air enter into the bottle in order to avoid a vacuum as in the case of rigid bottles.

It will be understood from the above that we have provided a method of manufacturing and shaping a hollow container such as a bottle from a thermoplastic mass or from bands of thermoplastic material and at the same time filling the container with a liquid such as milk comprising forming the thermoplastic mass or the bands of material into a tube, for example by extrusion or by heat and pressure introducing the liquid into the tube, then shaping the tube into a container of the desired shape. The method may be a continuous one in which the tube is formed steadily and fed forward to the shaping and sealing device which may operate in such a way that the closing and shaping of the end of a filled container e.g. in forming a bottleneck also seals the end of the tube for the following container and expels surplus liquid into the next container after which more liquid may be allowed to enter the tube and the next filled container may be formed in the same way. In this way measured quantities of liquid such as milk may be introduced at set intervals into the tube so that filled containers are formed one after the other.

By the above method containers for many different purposes and of many different shapes and sizes may be produced including of course bottles as described above and ampoules, phials and many other containers.

Dated this 21st day of October, 1947.
WITHERS & SPOONER,
Chartered Patent Agents,
148-150, Holborn,
London, E.C.1.
Agents for the Applicant.

PROVISIONAL SPECIFICATION.

Improvements in or relating to the manufacture of plastic fluid containers, especially ampoules

I, FELIX MEYER, of German nationality, of 112 Avenue Moliére, Brussels, Belgium, do hereby declare the nature of this invention to be as follows:—

It is well known that plastics and especially synthetic plastics are replacing other materials for a variety of purposes and I have been experimenting particularly with the manufacture of ampoules and similar containers from thermoplastic materials, for example as described in my co-pending Application No. 28096/47 (Serial No. 670313). During my experiments I had considerable difficulty owing to the tendency of the thermoplastic material to adhere or partially adhere to hot surfaces over which I was passing the material, for example in the form of sheets or lengths such as tapes. In particular I found that when passing tapes of thermoplastic material over hot metal rollers or over a hot metal surface there was a marked tendency for the tapes to stick to the metal rollers owing to the fact that the surface of the tapes became tacky in the heat.

It is an object of the present invention to overcome this difficulty when working with thermoplastic materials such as a thermoplastic cellulosic material among which ethyl cellulose or cellulose acetate may be mentioned or Polyamides or polyvinyl compounds including polyvinyl ester or polyvinyl chloride with or without polyvinyl acetate. There are a good many synthetic thermoplastic materials already on the market such as polystyrene, nylon, cellon and polyethylene hereinafter called polythene, and it is an object of the invention to prevent such materials sticking to hot metal surfaces such as hot rollers during manufacturing processes.

According to the invention when applying heat to thermoplastic material by means of heated metal rollers or by other heated surfaces which are liable to stick to the thermoplastic material, it is proposed to insert a buffer between the hot surface and the thermoplastic material, the said buffer consisting of a layer of other material which is not liable to stick to the thermoplastic material and which does not act as a heat insulator to any marked extent. For example I have found that an interposed buffer layer of paper or fabric is very satisfactory and so if a tape of polythene or other thermoplastic material is being passed over a heated metal roller I propose to insert a buffer material such as strong paper or isolated Cellophane (Registered Trade Mark) between the roller and the thermoplastic material. This buffer layer may consist of a strong paper cloth or fabric tape corresponding to the tape of thermoplastic material so that the two tapes may be fed forward together with the paper tape between the thermoplastic tape and the heated metal roller. In this way I have found that I can apply considerable heat to thermoplastic materials by means of hot metal rollers without causing the thermoplastic material to stick to the rollers. If the tape of thermoplastic material or two or more such tapes are to be passed between two hot metal rollers then two buffer tapes may be used to prevent direct contact between thermoplastic material and the hot metal.

As an alternative way of carrying the invention into effect when using heated metal rollers in relation to thermoplastic material, I have found that the buffer material may be applied in the form of a coat or sheath to the rollers in such a way that the rollers are encased in material which is not liable to stick to the thermoplastic material for example a suitable fabric. In some cases it may be desired to apply heat to sheets of thermoplastic material by ironing the said sheets and in order to do this satisfactorily it is proposed in accordance with a feature of the invention to interpose a buffer layer between the iron and the thermoplastic material.

In the manufacture of ampoules and similar small containers from thermoplastic materials, I have already proposed to employ a tape or tapes of the thermoplastic material and to shape the tape or tapes into a tube which may then be filled with liquid and divided into a number of individual compartments. The present invention may be used with advantage in connection with the manufacture of ampoules and other small containers by the method outlined above which may involve passing the tape or tapes over heated rollers and in which heat must be applied to seal the edges of the containers, for example when two tapes are used the tapes may be joined by sealing down the sides and may then be sealed together transversely of the tube at the requisite intervals to form the individual containers. In the above method whenever hot metal rollers

or hot metal surfaces are used, I propose in accordance with this invention to interpose a buffer layer in the manner described above. If desired the buffer layer itself may be caused to stick to the thermoplastic material so that the finished product comprises the thermoplastic material combined with a layer of fibrous material or paper or other buffer material adhering thereto.

Dated this 24th day of December, 1947.
WITHERS & SPOONER,
Chartered Patent Agents,
148-150, Holborn,
London, E.C.1.
Agents for the Applicant.

PROVISIONAL SPECIFICATION.

Improvements in or relating to the manufacture of plastic fluid containers, especially ampoules

I, FELIX MEYER, of German nationality, of 112 Avenue Moliére, Brussels, Belgium, do hereby declare the nature of this invention to be as follows:—

In my co-pending Application 28096/47 (Serial No. 670313) I have disclosed a number of methods for producing and filling ampoules and other like containers, made from suitable thermoplastic material such as polythene, either by extrusion or by uniting one, two or more tapes to form a tube which is filled and then sub-divided.

My experiments have shown that it is not easy to clean tapes of thermoplastic material until they are sufficiently free from dust and for this and other reasons it is difficult to sterilize the tapes. This means that special precautions may have to be introduced when making containers from tapes of thermoplastic material especially when the containers are being filled with medicament for injection purposes. These special precautions introduce complications and it is an object of the present invention to provide a method of making and filling these containers in which cleanliness and sterility are achieved without difficulty.

In my proposed new method a tube of thermoplastic material is made by extrusion, for example at 120°C. This tube may then be flattened and wound on to a storage roller in one length. The inside of this tube will be as near to sterility as it is possible to obtain, in view of the temperature at which the tube is extruded.

To fill this tube and divide it into individual containers the tube may be unwound from the storage roller and moved past a device which cuts open the tube along one side, through the cut a pipe may be introduced into the tube to feed in the contents and below the pipe entrance the material may be united again at the cut to reform the tube. The tube may therefore in accordance with the invention be cut open, a filling pipe may be introduced and the tube may then be reformed. The pipe may be made of glass, metal, rubber or other suitable material and the open end of the pipe may be bent to form an elbow so that the opening in the pipe is below the position at which reforming of the tube takes place. In this way the fluid contents may be fed into the tube below the resealing position. The filled tube may then be subdivided transversely and if desired also longitudinally to form individual containers which may be joined to the adjacent containers or may be separate. The transverse sealing is effected below the fluid surface to ensure that completely filled containers are made, the excess from one container being forced out into the one above during sealing.

If a large tube is being used, e.g. diameter 10″ and the containers required are small, e.g. diameter 1″, then suitable longitudinal division of the tube may be effected as described above to divide the tube into the required number of sections longitudinally. This may be effected by heated knives, rollers or the like, to give a continuous method. Alternatively an intermittent method may be used but I prefer the continuous method because it is important that the device for transverse sealing remains in contact with the material for about the same length of time at each sealing operation and this can more easily be arranged in a continuous process by having a star or like shaped heated roller rotating at the same speed as the advancement of the tube.

I should like to mention that my experiments have shown that these thermoplastic materials such as polyethylene usually called polythene are not water vapour proof, on the other hand I have found that considerably less water vapour evaporates through the walls of a filled container when the container is completely filled and there is no air bubble within the container. It may be here mentioned that before filling steps should be taken to render the liquid free from air. The transverse sealing under the level of the fluid ensures as far as possible that no air bubbles are present which is also desirable from the medical point of view and is difficult to achieve with normal glass ampoules.

If arrangements are made to feed the tube through the machine always at the same speed and if the deformation of the walls of the tube is controlled as by an outer

mould then within limits the contents of the containers will always be the same. The pressure exerted by the fluid column may be maintained constant by a device such as an autostat.

To avoid shrinkage of the material during subsequent final sterilization I have found it advisable after sealing off individual containers to remove any unwanted border of material around the container or containers, this may be effected by heated knives.

It will be appreciated that the above described method for making and filling these containers is given by way of example and various alternative methods are possible, for example the extruded tube may be cut open on both sides and may then be resealed along both sides in order to give a symmetrical container, but, of course, in this case the filling pipe is introduced from one side only.

These completely filled containers may be used with or without a hypodermic syringe, for example, when using a syringe the needle may be inserted through the container wall and the contents may be drawn out of the container by means of the syringe. The elasticity of the material is such that it closes around the needle and substantially none of the contents are lost. It will be understood that in this method of use the container may be punctured by the needle at any desired position. In accordance with another method of use, these containers may be employed without a syringe, for example a container may be punctured by one end of a double ended needle and the contents of the container may then be squeezed out through the needle simply by pressure of the finger and thumb.

The above two methods of using these containers, of course, have particular reference to medical ampoules. It will be understood, however, that this invention is not limited to the manufacture of such ampoules and containers for various fluids may be manufactured in accordance with the method described above.

Dated this 27th day of July, 1948.
WITHERS & SPOONER,
Chartered Patent Agents,
148-150, Holborn,
London, E.C.1.
Agents for the Applicant.

COMPLETE SPECIFICATION.

Improvements in or relating to the manufacture of plastic fluid containers, especially ampoules

I, FELIX MEYER, of German nationality of 112, Avenue Moliére, Brussels, Belgium, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to the manufacture and filling of plastic fluid containers especially plastic medical ampoules for hypodermic injection but also other similar plastic containers such as receptacles for liquid foodstuffs, beauty preparations, toilet preparations, and such like and in this specification the generic expression container is used to include all such receptacles.

Taking medical ampoules as an example, these have hitherto generally speaking been made of glass which up to a point has proved satisfactory. It is well known however that glass ampoules suffer from one or two inherent disadvantages, for example they are rather fragile, they are sometimes difficult to open without splintering and they are not usually capable of being completely filled and closed without any air inside. Containers for other fluids have been in the past made from a variety of substances including metal and glass. Of recent years it has been from time to time proposed to use a synthetic thermoplastic material such as polyethylene hereinafter called polythene in the manufacture of liquid containers. As an example of this technique prior specification No. 570451 may be mentioned which discloses a process for the production of protective-sealed containers around liquids, pastes or powders by extruding through a suitable orifice in a substantially downwards direction a tube of a thermoplastic synthetic resin composition which is solid at room temperature and at the same time carrying out a cycle of operations consisting of sealing a portion of the said tube, feeding through an aperture circumscribed by the said orifice the liquid, paste or powder into the interior of the tube in which the pressure is controlled through a vent also circumscribed by the said orifice and again sealing a portion of this tube above or behind the liquid, paste or powder, said sealing operations being accomplished by nipping the tube with jaws under conditions such that the resin composition so brought together is in the plastic state. It has also been proposed in Patent Specification No. 553563 to provide a process of forming liquid-filled gelatin capsules, comprising the steps of advancing a pair of gelatin strips downwardly between pocketed die rolls, sealing together marginal portions of said strips above said rolls to form thereof a liquid container or bag, intro-

ducing the capsule filling liquid into the container expanding portions of the side walls of the container into the pockets of said rolls to form registering complementary liquid-filled capsule portions, pressing annular portions of said strips surrounding said pockets to cause them to adhere together to form liquid-filled capsules and separating said capsules from the remaining portions of said strips.

It has also been proposed in Patent Specification No. 642530 to provide a machine for packaging fluent materials such as pastes, namely cold creams and suppositories or liquids, namely oils and hand lotions or powder. This earlier machine as proposed comprises means for feeding opposed strips of ductile material, means for heat sealing said strips together along longitudinal zones to form a tubular structure, means for heat sealing said strips together transversely at intervals to form packages each containing fluent material and means for pressing portions of said strips into contact inwardly of said transverse and longitudinal zones to form chambers and to force the fluent material into said chambers. In this earlier specification it is stated that one of the objects of the invention is to provide a machine for packaging fluent material so as to form a tube of opposed strips of ductile material in which the fluent material may be deposited after which the walls of the tube may be transversely pressed together at zones spaced longitudinally of the tube so as to form and bound compartments of predetermined shape and volume each compartment being completely filled with the fluent material, the strips being sealed together in areas surrounding the pressed zones.

In another proposal set forth in Patent Specification No. 591442 there has been suggested an apparatus for manufacturing and filling a container made of plastic material comprising a device for storing a pre-manufactured tube of plastic material, tools for applying heat and pressure to a region of the tube to close the tube at said region, means for feeding the tube from the storing device to the said tools, and a hollow member adapted to communicate with the interior of the tube for introducing into the tube material to be contained in each container, the arrangement being such that in operation, the said tools act successively on different regions of the tube as the tube is fed to the said tools thereby entrapping introduced material between two closed regions of the tube.

According to the present invention there is provided a method of making and filling containers comprising the steps of moving downwardly a tube of synthetic thermoplastic material closed at the lower end, slitting the tube longitudinally thereof, feeding fluid into the tube through the slit, resealing the slit in the tube and then sealing the tube transversely at spaced positions in order to divide the tube into a number of individual containers separated from one another by sealing means, each sealing operation being effected below the surface of the fluid in the tube so that excess fluid from one container is forced out into the next container above.

The invention also includes a machine for forming and filling containers comprising means for moving downwardly a tube of synthetic thermoplastic material closed at the lower end, means for slitting the tube longitudinally thereof, means for feeding fluid into the tube through the slit, means for resealing the slit in the tube and means for sealing the tube transversely at spaced positions in order to divide the tube into a number of individual containers separated from one another by sealing seams, each successive sealing operation being effected below the surface of the fluid in the tube so that excess fluid from one container is forced out into the container above.

It should be here mentioned that the synthetic thermoplastic material selected should be solid at room temperature so that a satisfactory practical plastic container may be produced, it should be substantially inert, that is to say it should not have any deleterious action on the contents, it should be flexible and as far as possible it should be impermeable to water vapour. At present all such thermoplastics are to a certain extent permeable to water vapour but some are better than others and when filling containers with volatile liquids this factor should be particularly borne in mind. As examples of two suitable synthetic thermoplastic materials I should like to mention polythene and chlorinated rubber which give very satisfactory results. Alternatively thermoplastic cellulosic materials may be used such as ethyl cellulose or cellulose acetate or other suitable synthetic thermoplastic material including polyvinyl compounds such as polyvinyl esters including polyvinyl chloride with or without polyvinyl acetate. The expression "synthetic thermoplastic material" as used in this specification therefore includes only non-metallic thermoplastic materials having the properties specified above which are suitable for formation into tapes or tubes to be manufactured into what I refer to as plastic containers.

The method of making and filling containers in accordance with the invention is preferably carried out as a continuous operation comprising the steps of moving a tube of synthetic thermoplastic material in a downward direction, closing the lower end of the tube, slitting the tube down one side, feeding fluid into the tube through the slit and dividing the tube into individual

completely filled containers by sealing the tube with narrow seams transversely thereof successively at a number of spaced positions, such sealing operation being above the previous seal and below the fluid surface so that excess fluid from the ampoule is forced out into the ampoule above, whereby completely filled ampoules are produced.

Going a stage further the complete method of forming the tube, filling it with fluid and then forming the individual containers may be carried out as a sequential series of operations. According to one such method the tube may be extruded in accordance with known technique and according to another method the tube may be formed from one or more than one tape of synthetic thermoplastic material. As an example, a method of making and filling containers using an extruded tube will hereinafter be described in more detail.

In accordance with this feature of the invention a tube of synthetic thermoplastic material may be produced by extrusion and the lower end of the tube may be sealed for example by heated star shaped rollers or by other suitable means. In this way the tube may be formed continuously in an endless length by forcing out the heated plastic mass through an extrusion orifice.

It is not necessary in accordance with this invention to feed in measured quantities of fluid in view of the fact that transverse sealing to divide the tube into the individual containers is effected below the surface of the fluid, the amount of fluid in each container being regulated by other means such as the speed of formation of the tube and the frequency of operation of the transverse sealing means. In accordance with this technique ready filled containers with, if desired, substantially sterile contents, may be produced in considerable numbers. If, for example, the tube is formed at a speed of one metre per minute and if it then travels between two heated fluted rollers which effect a narrow seal transversely of the tube every two centimetres, then fifty ready filled sealed, sterile containers may be produced per minute, each container having substantially the same amount of contents as any other.

In the above example a single die orifice is used to produce a single tube which is then slit longitudinally filled and divided into individual containers as described. Going a stage further, means may be provided to divide the tube longitudinally into two or more tubes by sealing longitudinally to produce additional containers. This longitudinal sealing is preferably done after filling the tube and before or after the transverse sealing. The invention may also be carried out in such a manner that several tubes travel adjacent to one another for example two, three or more and that different fluids are passed into each tube after each tube has been slit. This technique may be particularly useful in the case of medicaments and also for some foodstuffs that require mixing immediately before use.

According to the above technique therefore involving the use of an extruded tube there is provided a method of making filled containers comprising forming by downward extrusion a tube of synthetic thermoplastic material, closing the lower end of the tube, slitting the tube, feeding the fluid contents into the tube through the slit, closing the slit and then dividing the filled tube by narrow seams into a number of individual containers by transverse sealing in such a way that the excess fluid from one container is forced out during transverse sealing into the next container above. The transverse sealing is effected by heat which melts and seals together the opposite sides of the tube so that as the top of a formed container is sealed off, in the same operation the bottom of the next container above is sealed, the excess fluid from the formed container being pushed out during the sealing operation into the container above.

It will be understood that instead of using an extruded tube of synthetic thermoplastic material it is possible to start from one, two or more tapes of synthetic thermoplastic material which may be used in long lengths and joined together longitudinally by sealing to make a tube similar to the extruded tube described above but having narrow seams or joins therein. The tape or tapes may be shaped into a tube by moving their longitudinal edges past a device which fuses them together by heat. In possibly the most simple arrangement two tapes may be employed, joined longitudinally along the two edges but it will be realized that if desired three, four or even more tapes could be used to form for example containers of special size or shape, for example approximately square, rectangular or triangular in cross-section.

In the preferred arrangement two tapes are used, these tapes being continuously unwound from spools and passed over heated rollers shaped and adapted to seal the side edges of the tapes together longitudinally thereof to form a tube.

It will be appreciated that the individual ampoules as they are formed may remain attached together or they may be divided into entirely separated ampoules as required. Obviously by ringing the changes on this possibility many variations are possible, for example a block of inter-connected containers may be produced when tubes are divided both transversely and longitudinally into individual containers. This produces a block of containers similar to a slab of

chocolate with longitudinal and if necessary also with a number of transverse grooves. If it is desired that such a slab or plate should present a greater bulge on one side than on the other the thickness of the bands to be united can be so chosen that one band bulges out on filling to a greater extent than the other band.

During my experiments I have had considerable difficulty at times owing to the tendency of the synthetic thermoplastic material to stick or partially stick to hot surfaces over which I was passing the material, for example, in the form of tapes or tubes. In particular I found that when passing tapes or tubes of synthetic thermoplastic material over hot metal rollers or over a hot metal surface there was often a marked tendency for the tapes or tubes to stick to the metal rollers owing to the fact that the surface of the tapes or tubes become tacky in the heat.

According to a feature of the invention when applying heat to synthetic thermoplastic material by means of heated metal rollers or by other heated surfaces which are liable to stick to the synthetic thermoplastic material, it is proposed to insert a buffer between the hot surface and the thermoplastic material, the said buffer consisting of a layer of other material which is not liable to stick to the synthetic thermoplastic material and which does not act as a heat insulator to any marked extent. For example we have found that an interposed buffer layer of paper or fabric is very satisfactory and so if a tape of polythene or other thermoplastic material is being passed over a heated metal roller we propose to insert a buffer material such as strong paper or material known under the Registered Trade Mark Cellophane between the roller and the thermoplastic material. This buffer layer may consist of a strong paper cloth or fabric tape corresponding to the tape of synthetic thermoplastic material so that the tapes may be fed forward together with the paper tape between the thermoplastic tape and the heated metal roller. In this way we have found that we can apply considerable heat to the synthetic thermoplastic material by means of hot metal rollers without causing the synthetic thermoplastic material to stick to the rollers.

As an alternative way of carrying the invention into effect when using heated metal rollers in relation to synthetic thermoplastic material I have found that the buffer material may be applied in the form of a coat or sheath which may be applied or coated on to the rollers in such a way that the rollers are encased in material which is not liable to stick to the synthetic thermoplastic material for example a suitable fabric. This feature of the present invention may be used with advantage in connection with the manufacture of ampoules and other small containers by the method outlined above which may involve passing the tape or tapes over heated rollers and in which heat must be applied to seal the edges of the containers, for example, when two tapes are used the tapes may be joined by sealing down the sides and may then be sealed together transversely of the tube at the requisite intervals to form the individual containers. Whenever hot metal rollers or hot metal surfaces are used, I propose in accordance with a feature of this invention to interpose a buffer layer in the manner described above. If desired for certain containers the buffer layer itself may be caused to stick to the synthetic thermoplastic material so that the finished product comprises the synthetic thermoplastic material combined with a layer of fibrous material or paper or other buffer material adhering thereto.

Having given one or two examples of the method which may be used in accordance with the invention it may be desirable now to include general particulars of a machine suitable for carrying the method into effect. Reference is now therefore directed to the accompanying diagrammatic drawing which shows a machine according to the invention adapted to make filled ampoules. In the drawing a tube 19 of synthetic thermoplastic material is unwound from a drum 20 and is passed downwardly between two cutting rollers 21, 22 which open up the tube along one side by slitting it open, i.e. which make a vertical slit in the tube down one side. The liquid feed pipe 7 is introduced through the slit as shown and is turned downwards at the elbow 8 as described above. The slit tube is then passed between sealing rollers 23 and 24 which seal the slit in the tube. The filled tube is then passed through guides 12 to the transverse sealing rollers 13 and 14 and longitudinal sealing rollers 17 and 18 which seal the tube longitudinally thereof to produce a number of ampoules side by side.

In accordance with this method a tube of synthetic thermoplastic material may be made by extrusion, for example, at 120°C. This tube may then be flattened and wound on to the storage roller 20 in one length. The inside of this tube will be as near to sterility as it is possible to obtain, in view of the temperature at which the tube is extruded.

The pipe 7 may be made of glass, metal, rubber or other suitable material and the open end of the pipe 7 is bent as described to form an elbow so that the opening in the pipe is below the position at which reforming of the tube takes place. In this way the fluid contents may be fed into the tube below the resealing position. The filled

tube is then subdivided transversely by rollers 13, 14 and if desired also longitudinally by rollers 17, 18 as described to form individual ampoules which may be joined to the adjacent ampoules or may be separate. The transverse sealing is effected below the fluid surface to ensure that substantially completely filled ampoules are made, the excess from one ampoule being forced out into the one above during sealing.

If a large tube is being used, e.g., diameter 10″ and the ampoules required are small, e.g., diameter 1″, then suitable longitudinal division of the tube may be effected as described above to divide the tube into the required number of sections longitudinally. This may be effected by heated knives, rollers or the like, to give a continuous method.

Finally, I should like to mention that my experiments have shown that these synthetic thermoplastic materials such as polyethylene usually called polythene are not water vapour proof, on the other hand I have found that considerably less water vapour evaporates through the walls of a filled ampoule when the ampoule is substantially completely filled and there is no air bubble within the ampoule. The transverse sealing under the level of the fluid ensures as far as possible that no air bubbles are present which is also desirable from the medical point of view and is difficult to achieve with normal glass ampoules.

If arrangements are made to feed the tube through the machine always at the same speed and if the deformation of the walls of the tube is controlled as by an outer mould then within limits the contents of the ampoules will always be the same. The pressure exerted by the fluid column may be maintained constant by a device such as an autostat.

To avoid shrinkage of the material during subsequent final sterilization any unwanted border of material around the ampoule or ampoules should be removed. This may be effected by heated knives.

What I claim is:—

1. A method of making and filling containers comprising the steps of moving downwardly a tube of synthetic thermoplastic material closed at the lower end, slitting the tube longitudinally thereof feeding fluid into the tube through the slit, resealing the slit in the tube and then sealing the tube transversely at spaced positions in order to divide the tube into a number of individual containers separated from one another by sealing seams, each sealing operation being effected below the surface of the fluid in the tube so that excess fluid from one container is forced out into the next container above.

2. A method according to Claim 1 wherein an extruded tube is flattened and wound on to a spool for storage before use.

3. A method according to Claim 1 wherein the tube is produced by extrusion and wherein the subsequent forming slitting and filling operations are carried out as sequential steps in a continuous process.

4. A method according to Claim 1 wherein the tube is formed from one, two or more tapes secured together by a sealing seam or seams and wherein the forming slitting and filling operations are carried out as sequential steps in a continuous process.

5. A method according to any of the preceding Claims wherein the tube is sealed longitudinally as well as transversely after filling in order to form additional ampoules or like containers.

6. A method according to any of the preceding Claims wherein buffer material is provided between the synthetic thermoplastic material and any heated metal parts over which the material may be passed.

7. A machine for forming and filling containers comprising means for moving downwardly a tube of synthetic thermoplastic material closed at the lower end means for slitting the tube longitudinally thereof, means for feeding fluid into the tube through the slit, means for resealing the slit in the tube and means for sealing the tube transversely at spaced positions in order to divide the tube into a number of individual containers separated from one another by sealing seams, each successive sealing operation being effected below the surface of the fluid in the tube so that excess fluid from one container is forced out into the container above.

8. A machine for forming and filling plastic ampoules and like containers comprising a guide, means to present a substantially continuous tube to the guide so that the tube passes along the guide in a downward direction, a knife associated with the guide and extending in general in overlapping relation thereto to continuously slit the tube along one side, a filler pipe positioned subsequent to the knife in the direction of travel of the tube and entering the slit in the tube, means to feed fluid into the tube through the filler pipe, means to reseal the slit in the tube below the filler pipe and means for sealing the tube transversely at spaced positions in order to divide the tube into a number of individual containers separated from one another by sealing seams, each successive sealing operation being effected below the surface of the fluid in the tube so that excess fluid from one container is forced out into the container above.

9. A method of making containers substantially as hereinbefore described.

10. A machine for carrying out the method claimed in Claim 9 substantially as

hereinbefore described with reference to the accompanying drawings.

WITHERS & SPOONER,
Chartered Patent Agents,
148-150, Holborn,
London, E.C.1.
Agents for the Applicant.

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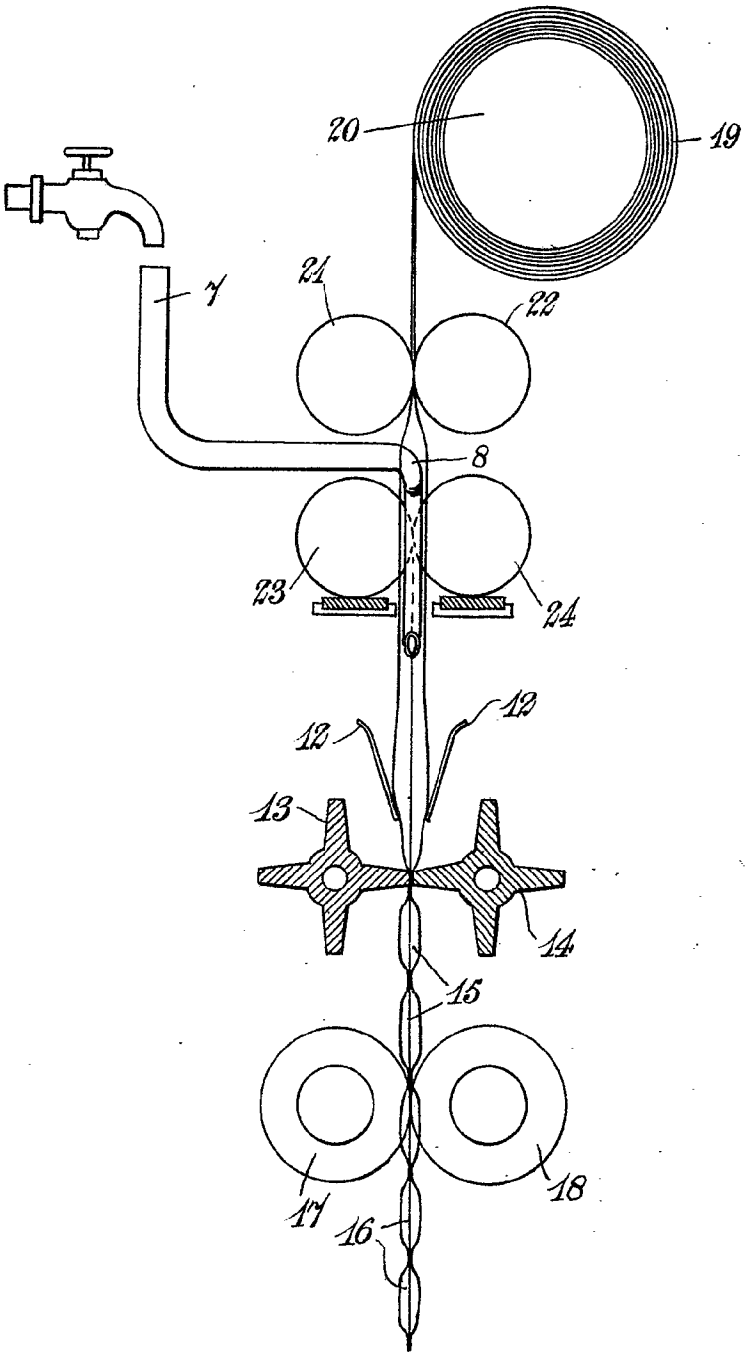

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H.M.S.O. (M.F.P.)